Original Research Article

Performance of CT scan in predicting the feasibility of primary optimal cytoreduction in ovarian cancer

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ABSTRACT

Background: Ovarian cancer is frequently diagnosed at an advanced stage and optimal cytoreduction remains the most important prognostic factor for survival. Accurate preoperative assessment is essential to identify patients who are likely to benefit from primary debulking surgery. This study evaluated the diagnostic performance of CT scanning and a structured CT scoring system in predicting optimal cytoreduction among women with suspected ovarian cancer. This study aimed to assess the accuracy of preoperative CT findings and total CT score in determining the feasibility of optimal cytoreduction.

Methods: This prospective observational study was conducted at Gynecological Oncology Unit, Department of Obstetrics and Gynecology, Dhaka Medical College Hospital, Dhaka, Bangladesh, from July 2021 to June 2022. Fifty patients with suspected ovarian cancer underwent contrast-enhanced CT scanning before primary cytoreductive surgery. Five CT parameters were evaluated and assigned scores from 0 to 2, producing a total CT score ranging from 0 to 10. CT findings were compared with peroperative findings and histopathology. Diagnostic performance, associations between CT score and surgical outcome were analyzed using SPSS.

Results: Optimal cytoreduction was achieved in 70% of patients. CT showed high sensitivity for ascites, omental involvement, peritoneal thickening and lymph node metastasis. Increasing CT score correlated with a higher likelihood of suboptimal cytoreduction. A CT score ≥3 demonstrated a specificity of 100% and a significant association with suboptimal debulking.

Conclusions: Preoperative CT assessment, particularly total CT score, is a valuable tool for predicting optimal cytoreduction and guiding treatment decisions in ovarian cancer.

Keywords: Ovarian cancer, Cytoreductive surgery, CT scan, Predictive score, Debulking outcome

INTRODUCTION

Ovarian cancer remains one of the most lethal gynecologic malignancies worldwide, largely due to its late presentation and the high proportion of patients diagnosed at advanced stages. In Bangladesh, the annual mortality rate associated with ovarian cancer has increased by more than 40% since 1990, reflecting both evolving epidemiological patterns and persistent barriers to early detection.[1] Globally, approximately 200,000 women are diagnosed with ovarian cancer every year and it accounts for nearly 5% of all cancer-related deaths among women.[2] The predominance of epithelial ovarian cancers, which constitute nearly 90% of all cases, coupled with their insidious clinical course, contributes substantially to the observed diagnostic delays and treatment challenges.[3]

The clinical outcome in ovarian cancer is closely linked to the stage at diagnosis and the volume of residual disease following cytoreductive surgery. Achieving optimal cytoreduction, defined as leaving no residual tumor or residual disease ≤1 cm, has consistently been shown to be the strongest predictor of survival.[4] However, not all patients benefit from aggressive primary debulking surgery and those with unresectable or difficult-to-resect disease often face the risk of extensive surgical morbidity without meaningful therapeutic advantage. Consequently, appropriate preoperative identification of patients likely to achieve optimal cytoreduction is crucial for tailoring management strategies, including selecting candidates for neoadjuvant chemotherapy.[5]

Computed tomography (CT) is widely used as the primary imaging modality for preoperative evaluation of suspected ovarian cancer due to its accessibility, speed and capacity to identify intra-abdominal disease spread. CT is integral not only in the detection of adnexal masses but also in characterizing peritoneal involvement, omental disease, lymph node metastasis and diaphragmatic or liver surface implants. Several investigators have attempted to establish CT-based radiologic criteria that predict the feasibility of optimal cytoreduction, with reported predictive accuracies ranging from 71% to 93%.[6,7] CT-based decision-making can help differentiate patients who may benefit from primary debulking surgery from those more appropriately treated with neoadjuvant chemotherapy, thereby reducing unnecessary operative morbidity.[8]

Despite its central role, CT imaging is limited by its inability to detect microscopic disease and its predictive performance varies across studies due to differences in patient characteristics, imaging techniques and institutional expertise. The use of structured CT scoring systems that quantify disease burden at specific anatomical sites has been proposed as a strategy to improve predictive accuracy. Such scoring systems focus on parameters such as ascites volume, omental caking, peritoneal thickening, retroperitoneal lymphadenopathy and diaphragmatic or lung base deposits, each of which has been associated with unresectability.[9]

In Bangladesh, there is a lack of comprehensive institutional data evaluating the performance of CT in predicting optimal cytoreduction among women presenting with suspected ovarian malignancy. Given the rising burden of ovarian cancer and the increasing need for precision in preoperative assessment, understanding the diagnostic performance of CT within local clinical and resource contexts is essential. The present study was designed to evaluate the agreement between preoperative CT findings and intraoperative assessments and to determine whether CT including a structured five-parameter CT scoring system can accurately predict the feasibility of optimal primary cytoreduction.

The study focuses on systematically assessing the diagnostic performance of CT parameters and exploring their relationship with surgical outcomes in a cohort of women undergoing primary debulking surgery. By comparing radiologic features with peroperative findings and analyzing their predictive value for optimal cytoreduction, this work aims to strengthen evidence supporting the role of CT in preoperative surgical planning. Moreover, the findings intend to support clinicians in refining treatment algorithms and reducing unnecessary surgical interventions. This aligns with global efforts to optimize patient selection for primary surgery and promote individualized, evidence-based management of ovarian cancer.

METHODS

This prospective observational study was conducted at Gynecological Oncology Unit, Department of Obstetrics and Gynecology, Dhaka Medical College Hospital, Dhaka, Bangladesh. Data collection was carried out over a 12-month period from July 2021 to June 2022. A total of 50 patients meeting the study criteria were enrolled. The study population comprised women with clinical and radiologic suspicion of ovarian cancer who were scheduled for cytoreductive surgery.

Sample selection

Inclusion criteria

Patients with suspected ovarian cancer on clinical examination; patients with preoperative CT scan of the abdomen and pelvis; availability of preoperative CA-125 values; patients planned for primary cytoreductive surgery were included.

Exclusion criteria

Patients unable to understand written and/or oral information; patients with poor performance status (ECOG 3 or 4) were excluded.

Patients with stage III or IV disease involving the small bowel mesentry, stomach, lesser sac, or para-aortic lymph nodes above the renal vessels on CT findings (these patients were referred for neoadjuvant chemotherapy).

Study procedure

After informed consent, each participant underwent a detailed clinical evaluation. Preoperative investigations included CA-125 measurement, transvaginal sonography when applicable and contrast-enhanced CT scan of the abdomen and pelvis. CT scans were performed using a standardized protocol: oral and intravenous contrast administration, craniocaudal imaging from the diaphragm to the ischial tuberosities and 5-mm slice thickness.

Five CT parameters peritoneal thickening, omental involvement, pelvic and para-aortic lymph nodes, diaphragm and lung bases and ascites volume were assessed. Each parameter was assigned a score from 0 to 2, yielding a total CT score ranging from 0 to 10. This score was compared with peroperative findings.

All patients underwent primary cytoreductive surgery performed by gynecologic oncologists, which included total hysterectomy, bilateral salpingo-oophorectomy, omentectomy, retroperitoneal lymph node dissection and resection of all visible tumor deposits. Appendectomy, bowel resection and diaphragmatic scraping were performed when required to achieve optimal cytoreduction. Operative findings were recorded using a structured case record form.

Ethical considerations

Ethical approval was obtained from the Institutional Ethical Committee of Dhaka Medical College Hospital prior to study initiation. Written informed consent was obtained from all participants. Confidentiality and anonymity of all patient information were strictly maintained throughout the study.

Statistical analysis

Data were analyzed using SPSS version 26. Descriptive statistics were used for demographic variables, presented as frequency and percentage. Sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) were calculated for each CT parameter by comparing CT findings with intraoperative observations. Associations between CT parameters, total CT score, CA-125 level and surgical outcome (optimal vs. suboptimal cytoreduction) were evaluated using the Chi-square test. A p-value <0.05 was considered statistically significant.

RESULTS

Table 1 shows the age distribution of the study subjects. Majority of the study patients 23(46.0%) belonged to age group 51-60 years. Minimum age was 30 years and maximum age was 70 years. Mean±SD age 53.56±9.52 years.

Table 1: Distribution of cases according to age (n=50).

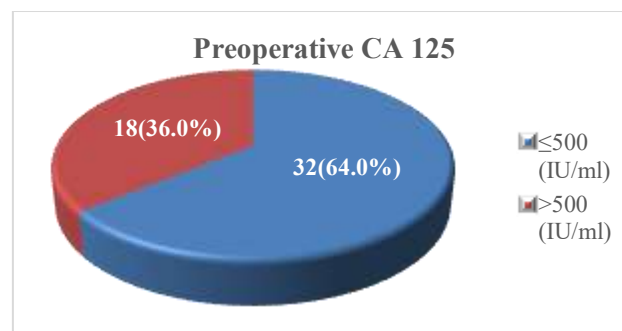| Age in years	Frequency (N)	Percentage (%)
30-40	7	14
41-50	8	16
51-60	23	46
61-70	12	24
Mean±SD	53.56±9.52	
Range	(30-70) years	

Figure 1: The preoperative CA 125 value (n=50).

Figure 1 denotes 64% of the patients had preoperative CA 125 ≤500IU/ml and 36% patients had CA 125 above 500IU/ml.

Table 2: Distribution of the patients by tumor stage, grade and histopathology of the tumor (n=50).

Parameters	Frequency (N)	Percentage (%)
Figo staging of tumor on staging laparotomy		
Stage I	11	22
Stage II	2	4
Stage III	31	62
Stage IV	6	12
Grading of tumor		
Grade I	4	8
Grade II	15	30
Grade III	31	62
Histopathology of tumor		
Serous cyst adenocarcinoma	39	78
Mucinous cyst adenocarcinoma	8	16
Endometrioid carcinoma	2	4
Clear cell carcinoma	1	2

Table 2 shows maximum (62.0%) patients had stage III, followed by 22.0% patients who had stage I disease. Maximum patients (62.0%) had tumor grade III; 30.0% patients had grade II. Histopathology of the tumor was reported as 78% serous cyst adenocarcinoma, 16% mucinous cyst adenocarcinoma 4% endometrioid carcinoma and 2% clear cell carcinoma.

Table 3 shows 70% of the patients had optimal cytoreduction and 30.0% patients had sub-optimal cytoreduction.

Table 4 Shows that out of 50 patients, 25(50.0%) cases had detected with ascites, 22(44%) cases with peritoneal involvement, 17(34%) cases with retroperitoneal lymph nodes involvement, 25(50.0%) cases with omental involvement, 5(10.0%) cases with diaphragm and lungs bases deposits by CT and peroperatively, which indicate true positive.

Table 3: Distribution of patients by surgery outcome (n=50).

Surgical outcome	Frequency (N)	Percentage (%)
Optimal cytoreduction	35	70
Sub-optimal cytoreduction	15	30
Total	50	100

Table 4: Comparison of preoperative CT findings with per operative findings (n=50).

CT parameters	Per-operative findings		P value
	Present (%)	Absent (%)	
Volume of ascites			
Present	25 (50.0)	6 (12.0)	0.001
Absent	5 (10.0)	14 (28.0)	
Peritoneal involvement			
Present	22 (44.0)	4 (8.0)	<0.001
Absent	7 (14.0)	17 (34.0)	
Retroperitoneal lymph nodes			
Present	17 (34.0)	5 (10.0)	<0.001
Absent	6 (12.0)	22 (44.0)	
Omentum			
Present	25 (50.0)	2 (4.0)	<0.001
Absent	5 (10.0)	18 (36.0)	
Diaphragm and lung bases			
Present	5 (10.0)	1 (2.0)	0.028
Absent	16 (32.0)	28 (56.0)	

Table 5: Diagnostic performance of CT scan with five preoperative CT scan parameters.

CT parameters	Sensitivity	Specificity	PPV	NPV	Accuracy
Volume of ascites	83.33	70	80.65	73.68	78
Peritoneal involvement	75.86	80.95	84.61	70.83	78
Retroperitoneal lymph nodes	73.91	81.48	77.27	78.57	78
Omentum	83.33	90	92.59	78.26	86
Diaphragm and lung bases	23.81	96.55	83.33	63.64	66

Table 6: Diagnostic performance of CT scan with five preoperative CT parameters.

CT parameters	Sensitivity	Specificity	PPV	NPV	Accuracy
Volume of ascites	81.82	76.47	87.1	68.42	80
Peritoneal involvement	76.67	85	88.46	70.83	80
Retroperitoneal lymph nodes	73.08	87.5	86.36	75	80
Omentum	86.67	95	96.3	82.61	90
Diaphragm and lung bases	26.32	96.77	83.33	68.18	70

Table 5 shows the results of CT detection of tumor at specific sites. CT was highly sensitive in the diagnosis of omental involvement, presence of ascites, peritoneal involvement and retroperitoneal lymph node involvement with a sensitivity of 83.33%, 83.33%, 75.86% and 73.91% respectively. Sensitivity to detect diaphragm and lung base deposits was very low23.81%.

Table 6 shows the results of CT detection of tumor at specific sites. CT was highly sensitive in the diagnosis of true invasion of tumor at specific sites. But sensitivity to detect diaphragm and lung base invasion was very low 26.32%.

Table 7 represents the total score and the surgical outcome. It was observed that as the total score increased, the number of patients who underwent sub-optimal cytoreduction also increased. 24 out of 24 cases (100%) with a total score of 0, 1 and 2 underwent optimal cytoreduction. Amongst 26 patients with scores of 3, 4, 5, 6 and 7, 15 (57.7%) underwent sub-optimal cytoreduction.

Table 8 demonstrates the surgical outcome with the total score. A total score of 3 or higher was used to classify a tumor as unlikely to be optimally debulked with surgery. The sensitivity of this system was 68.6% and the specificity was 100%. P value was found to be p<0.001, which is statistically significant. The higher the pre-operative CT score, the smaller the number of optimal debulking.

Table 7: Pre-operative total CT scan score comparison with optimal and suboptimal debulking (n=50).

Total CT score	N	Optimal (%) (n=35)	Sub-optimal (%) (n=15)
0	8	8 (100.0)	0 (0.0)
1	6	6 (100.0)	0 (0.0)
2	10	10 (100.0)	0 (0.0)
3	9	7 (77.8)	2 (22.2)
4	6	2 (33.3)	4 (66.7)
5	5	2 (40.0)	3 (60.0)
6	4	0 (0.0)	4 (100.0)
7	2	0 (0.0)	2 (100.0)
Total	50	35 (70.0)	15 (30.0)

Table 8: Association of total preoperative CT scores with surgical outcome (n=50).

Total CT score	Optimal (%) (n=35)	Sub-optimal (%) (n=15)	Total (%) (n=50)	P value
≥3	11 (31.4)	15 (100.0)	26 (52.0)	<0.001
<3	24 (68.6)	0 (0.0)	24 (48.0)	
Total	35 (100)	15 (100.0)	50 (100.0)	

DISCUSSION

This prospective observational study was conducted to compare preoperative CT scan findings with per-operative findings in order to evaluate the performance of CT in predicting resectability in ovarian cancer. Imaging plays a crucial role in the diagnosis and management of ovarian malignancy. It helps detect and characterize adnexal masses, recognize features suggestive of alternative diagnoses, identify metastatic spread to avoid understaging and detect specific regions of disease that may be unresectable.[10] Ultrasonography is often the first imaging modality used for evaluating adnexal masses; however, despite its usefulness when combined with transvaginal scanning, Doppler assessment and tumor markers, ultrasonography is limited in assessing global peritoneal spread and objectively quantifying disease extent. CT, therefore, serves as a superior modality for comprehensive evaluation of disease dissemination in ovarian cancer, even though definitive staging remains surgical.

CT has been validated as an accurate imaging method to predict the likelihood of successful cytoreduction. The distribution and extent of disease visible on CT often determine whether complete or near-complete cytoreduction is achievable. When CT features appear favorable, primary surgery aimed at complete resection (R0) or minimal residual disease (R1) offers the best clinical outcome.[11] Although staging is ultimately surgical, preoperative CT scanning is routinely recommended because findings involving the gastrointestinal and urinary tracts may alter the operative plan. CT is also capable of identifying peritoneal, hepatic, diaphragmatic and bowel serosal deposits, which are critical for assessing resectability.

In this study, 50 patients with clinical and radiologic suspicion of ovarian cancer were included. The majority (46%) belonged to the 51–60-year age group, with a mean age of 53.56 years, closely aligning with findings reported by Naik et al (median age 54.6 years), Ferrandina et al (median age 59 years) and Gerestein et al (median age 62.4 years).[10,12,13] Most patients presented at advanced stages, with 62% diagnosed at FIGO stage III. Histopathology revealed that serous carcinoma was the predominant subtype, consistent with global patterns and matching the distribution observed in earlier reports.[10]

In this study, 70% of patients underwent optimal cytoreduction, a rate comparable with the findings of Naik et al and higher than those in studies by Gerestein et al and Mousavi et al, where only 41–45% of patients with advanced-stage disease achieved optimal debulking.[13,14] The relatively high cytoreduction rate in the present study may be attributed to the inclusion of patients with early-stage disease, who typically have a higher likelihood of achieving optimal resection. All surgeries were performed by gynecologic oncologists, ensuring standardization of

operative technique and 96% of cases were confirmed as primary ovarian malignancy.

A total of 15 patients underwent suboptimal cytoreduction. Common reasons for incomplete resection included bowel mesenteric involvement, liver parenchymal deposits, subdiaphragmatic nodules larger than 2 cm and disease at the splenic hilum- representing anatomical regions known to compromise resectability.

The performance of CT in predicting disease burden at individual metastatic sites was generally comparable with published literature. Sensitivity and specificity for detecting ascites in this study were 83.33% and 70.00%, respectively, consistent with Naik et al, who reported a sensitivity of 100% and a specificity of 71.4% and Nelson et al, who reported a sensitivity of 85% and a specificity exceeding 90%.[10-15] CT also demonstrated an accuracy of 78% in detecting peritoneal involvement, similar to accuracy values reported by Ferrandina et al and Bristow et al (78.5% and 80.5%, respectively).[12-16] For omental involvement, sensitivity and specificity in this study were 83.33% and 90.00%, respectively, aligning with values from Nelson et al, Glaser et al and Meyer et al, who reported sensitivities ranging from 72-83.3% and specificities from 65–100%.[15,17,18]

Retroperitoneal lymph node involvement in this study was detected with a sensitivity of 73.91% and specificity of 81.48%. These findings were comparable with those of Naik et al and Ferrandina et al, supporting CT's reliability for assessing nodal disease.[10-12] However, the diaphragm and lung base deposits exhibited low sensitivity (23.81%) despite high specificity (96.55%). This aligns with prior studies indicating that CT frequently underestimates subdiaphragmatic deposits smaller than 5 mm, though specificity remains high across investigations.[15-18]

CT's most important limitation is its inability to detect microscopic peritoneal deposits, subtle bowel serosal disease and small subdiaphragmatic nodules. These challenges are well documented, though multiphasic acquisition and multiplanar reconstruction have improved detection in some regions.[19]

The CT scoring system used in this study demonstrated strong predictive capacity. A total CT score ≥3 correlated significantly with suboptimal cytoreduction. All patients with scores <3 underwent optimal debulking, while higher scores corresponded with increasingly unresectable disease. This observation aligns with previous reports by Axtell et al. and Bristow et al, which identified radiologic markers such as peritoneal thickening, omental caking and diaphragmatic disease as significant predictors of suboptimal surgery.[7-16]

Overall, the findings reinforce the utility of CT not only for anatomical assessment but also as a tool for predicting operative success. Incorporating a structured CT scoring approach improves preoperative risk stratification and may reduce unnecessary laparotomies, especially in settings lacking access to laparoscopy or advanced imaging modalities.

CONCLUSION

CT scan has been used extensively as a diagnostic and surveillance tool in patients with ovarian cancer. Although CT scan is too insensitive to detect very small metastatic foci for appropriate staging in ovarian cancer, our study suggests that it may be useful in determining operability. The use of a CT scoring system emphasizing multiple potential disease locations appears to improve accuracy. Hence, CT scan may help select patients who might be more appropriately managed by neoadjuvant chemotherapy. This study has attempted to reduce the uncertainty as to which patient should be initially subjected to neoadjuvant chemotherapy and which patients can be directly taken up for primary debulking surgery.

Limitations

The limitations of the study include the small sample size due to the short duration of the study. The study population was selected from a single hospital in Dhaka city, so the results may not reflect the broader national picture. Future studies should be conducted with larger sample sizes and across multiple centers.

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